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No. 23H

Statistics Canada
Analytical Studies Branch

Research Paper Series

Canada

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Business and Labour Market Analysis Group
Analytical Studies Branch
Statistics Canada
1990

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Aussi disponible en français

ABSTRACT

The relationship between the picture of the intensity of the competitive process given by measures of market structure in contrast to measures of intra-industry mobility is investigated herein using principal component and canonical correlation analysis. The main dimension of concentration is related closely to the intensity of entry and exit. The other dimensions of concentration capture the importance of a secondary group of firms and are related to different aspects of intra-industry mobility such as continuing firm turnover. Using regression analysis, the paper finds that entry and exit is a significant determinant of concentration even after scale effects are considered.

KEYWORDS: Determinants of Concentration; The Effect of Mobility on Concentration

Received: March 29, 1990
Accepted: May 14, 1990

Acknowledgements

This work has been made possible by Statistics Canada and is part of a project entitled "The Dynamics of the Competitive Process". Additional financial support has been received from the Economic Council of Canada, the Institute for Economic Research and the Graduate School at Queen's University, and from the SSHRC. Other papers in this series may be found in the Research Paper Series of the Analytical Studies Division, Statistics Canada.

The authors wish to thank Garnett Picot and John McVey of Statistics Canada for their aid and encouragement during this project. Garnett Picot supported and encouraged the research in the accompanying papers as part of the output of the Business and Labour Market Analysis Group. John McVey recognized at an early stage the need to establish identifiers that could be used for longitudinal work and supervised the establishment of such identifiers. More recently, this task has been the responsibility of Janice McMechan of the Business and Labour Market Analysis Group. Jocelyne Bousfield has provided the technical assistance in maintaining the identifiers. Clyde Drodge of the Economic Council provided programming assistance to us on several occasions.

Others in Statistics Canada who freely gave their time and advice during the project include Jacob Ryten, John Crysdale, Ken Young, and Harley Potter.

Comments on this paper were received from Klaus Steggeman.

THE RELATIONSHIP BETWEEN MOBILITY AND CONCENTRATION IN THE CANADIAN MANUFACTURING SECTOR

INTRODUCTION

The Austrian school has long held that competition is best described as a process. It is the system by which entrepreneurs vie freely for success. Different strategies are employed to produce goods that satisfy the consumer. Gambles are taken as resources are committed to discovering new products and new processes. Advertising campaigns are mounted to persuade the consumer to sample a particular product line. In the Austrian view, it is the intensity of the contest that must be used to evaluate the process.

An alternate and more traditional view, emanating primarily from a North American tradition, is that competition can be approached as a state of affairs. This position takes the view that the dimensions of the competitive system, as complex as they might be, can be meaningfully reduced by the use of a suitable classification system. The North American structuralist tradition has emphasized the use of statistics that summarize a state of affairs rather than a process. The structuralist school uses measures of market structure derived from the firm size distribution as proxies for the intensity of competition. The firm size distribution is a static measure that depicts the state in which an industry finds itself, rather than the process that has brought it to that position.

At a conceptual level, the two sides may not disagree as to what constitutes highly competitive markets. It is at the practical level of measurement that they differ. Those who use measures of market structure are, faute de mieux, focusing on a state of affairs. In using these measures, they are making certain strong presumptions about the ability of such measures to represent the intensity of competition within the industry.

The potential weakness of the structuralist school arises because, in the best traditions of social science, the structuralists have been willing to move beyond verbal descriptions of the intensity of competition to measurement. Those who look at competition as a state of affairs have in some sense been forced into this position by their attempt to measure the phenomenon. Data related to firm size distributions at a point in time have been readily available; on the other hand, longitudinal data that follow a firm over time are required to generate statistics that describe various aspects of the intensity of the competitive process. Such data have not been as accessible to researchers.

This paper is an attempt to bridge the gap between the two positions. It employs a micro-economic data base for the Canadian manufacturing sector that follows plants and firms over time to measure the extent to which there is intra-industry change in relative firm size during the 1970s. Various measures are calculated that directly capture the dynamics of the market process. Referred to as mobility measures, these statistics are used to evaluate the appropriateness of looking at competition as a state rather than a process. This is done by examining the extent to which the traditional measures used by structuralists are related to the mobility measures.

Investigation of the relationship between concentration and mobility can be compared to a study of the connection between the outside and the inside of a box. Market structure measures like concentration, in that they depict the firm size distribution, provide a picture of the outside of the box. Inside the box, firms are growing and declining, entering and exiting as competitive forces separate the successful from the unsuccessful. Traditionally, measures of the outside have been used to proxy the intensity of competition inside.

This study starts with the presumption that much of what happens during the competitive process will be manifested by change in relative firm position and that mobility measures provide a more direct measure of the intensity of competition. As a result of the competitive struggle, firms will grow and decline, enter and exit from different markets. The intensity of the competitive process will separate the unsuccessful from the successful.

Not all aspects of the competitive struggle will be translated into a shift in relative market share. In some instances, an intensely bitter struggle may leave all parties in the same relative position as at the outset. But this paper makes a start by measuring more of the process than has been previously done. And for those who believe the probability is extremely small that a struggle can be intense without a winner emerging, this contribution may be sufficient.

- Focus on the Four-Firm Concentration Ratio

Because of the large number of summary statistics that have been used to measure structure and the various aspects of internal mobility, establishing the relationship between measures of the intensity of the competitive process and the state of competition is potentially difficult. One resolution of this problem is to arbitrarily chose a measure of market structure and to relate it to one or more measures of mobility in a simple fashion. This is akin to asking whether concentration statistics, when employed on their own in a simple fashion, adequately describe the various aspects of competition. It is a relevant question to pose because of the importance that has been given to this measure in the annals of anti-trust policy. Lest it be forgotten, the Neal U.S. anti-trust task force recommended in 1968 the break-up of firms in industries where the four-firm concentration ratio exceeded 70% (Yamey,1985,119). U.S. merger guidelines also have stressed the importance of the four-firm concentration ratio. If it were not for the predominant reliance upon the four-firm concentration ratio in academic and policy circles, putting it to these tests might be regarded as unfair.

When the four-firm concentration ratio is put to the test, it is found to perform poorly as a proxy for the intensity of competition for several reasons.[1]

First, since measures of market structure approximate the size distribution of firms and the firm size distribution changes slowly, they implicitly suggest that little intra-industry change occurs over time. For example, the mean level of the four-firm concentration ratio across 167 4-digit Canadian manufacturing industries was 50.9% in 1970 and 49.9% in 1979. Similar findings for Canada (Krause and Lothian, 1988) and for other countries (Schmalensee, 1988) have been reported. These type of numbers have been used to suggest that change in market structure, if it occurs at all, takes place at a glacial pace (Scherer, 1980, p.70).

Although market structure may be slow to change, there is considerable turnover occurring within industries as the successful supplant the unsuccessful. For example, at the 4-digit industry level, about one-third of market share on average was shifted from those Canadian manufacturing firms losing market share between 1970 and 1979 to those gaining market share.[2] This was about equally split between firm turnover due to entry and exit and that due to the rise and fall of continuing producers. This contrasts sharply with the picture of stability painted by concentration data.

There is a second sense in which the simple four-firm concentration ratio may be said to imperfectly proxy the intensity of the competitive process at work within each industry. Intra-industry change can be measured by examining various aspects of the magnitude and pattern of market share or rank shifts. Entry and exit, the amount of shifting within the incumbent population, the extent to which growth rates are highly variable, and the tendency of large firms to regress towards the mean all provide valuable information on the nature of the competitive process at work.

When the concentration ratio is correlated with these various measures, no clear pattern emerges. If concentration is to be a good proxy, it should demonstrate a consistently strong relationship across the various mobility measures. It does not do so. The 1979 four-firm concentration ratio is strongly correlated with mobility statistics that measure the amount of turnover arising from entry and exit between 1970 and 1979 but its correlation with other mobility measures, like the amount of continuing firm turnover or the extent to which there is regression to the mean in firm size, is lower or insignificant.

The four-firm concentration ratio also does an imperfect job of ranking industries on the basis of their mobility characteristics. The top 35 most concentrated 4-digit Canadian manufacturing industries are not the 35 with the least regression to the mean in large firm shares, the ones with the least incumbent turnover or the ones with the least entry and exit. But just as the four-firm concentration ratio is correlated most highly across 167 4-digit industries with the entry and exit turnover mobility measure, it also comes closest to providing the same list of 35 potential problem industries as does the amount of turnover in an industry coming from entry and exit.

The four-firm concentration measure then fails the test set for it if the state of competition is to adequately describe the competitive process--if the outside of the box is to closely relate to the inside. It fails to do an adequate job because the competitive process is sufficiently complex that a single measure of structure all too often gives the wrong signal. The competitive process has too much variety to be easily summarized by a single measure of the outside dimensions of the process.

- Consideration of a Set of Market Structure Measures

While the four-firm concentration measure may do a poor job of describing the variety of competitive situations that exist, it would be unwarranted to conclude that the state and the process of competition are unconnected. The evidence of the previous section suggests that the relationship between the four-firm concentration ratio and various measures of mobility

is complicated and that the four-firm ratio should not be relied on alone to describe the intensity of the competitive process.

There is a second reason that further analysis is required. There are other measures of market structure that have not been considered. Their connection to the intensity of the competitive process also needs to be examined before the relationships between the measures of the outside and the inside of the box are fully understood.

The remainder of this paper is devoted to exploring these relationships by using a full set of statistics that summarize both market structure and mobility. The relationship between concentration and mobility is examined using principal component, canonical correlation, and regression analysis.

Principal component analysis is employed to enumerate the various dimensions of concentration and mobility and to examine their independence. It is used to determine if the dimensions in each of the data sets are sufficiently different to argue that mobility statistics provide additional information to that contained in concentration statistics.

While the principal component analysis finds generally that concentration and mobility statistics contain different dimensions, not all of the dimensions contained within each data set are independent of one another. There are some linkages between the two sets of measures. These are explored further with canonical correlation analysis. The latter examines the correlation between the different dimensions of concentration and mobility.

Principal component and canonical correlation analyses explore the broad relationships between the concentration and mobility measures without concern for causality. When the question of causality arises, it becomes important to consider the effect of other variables, in order to determine whether the variation in concentration, for example, is equally well accounted for by variation, not in mobility, but in the standard explanation of plant and firm scale. Therefore, the last section of the paper uses regression analysis to investigate the relationships that exist between concentration and mobility measures. It attempts to "explain" the level of concentration and changes in concentration over the decade of the seventies. It asks whether the contents of the box--the extent and the pattern of intra-industry firm mobility--enable us to say something about the outside--the market structure.

The attempt to explain the causes of concentration with mobility has its roots in the work of those economists like Simon and Bonini (1958) who modelled markets as stochastic processes and demonstrated that certain measures of mobility may determine the degree of concentration. For explanatory variables, the regression analysis uses not only technical factors, such as scale economies, but also various mobility indicators. Mobility is found to be related to concentration even when the scale factors are taken into account.

INVESTIGATING THE RELATIONSHIP BETWEEN MOBILITY AND CONCENTRATION STATISTICS

Differences Between The Dimensions of Mobility and Concentration Statistics

Several facets of the results of intra-industry competition have been used to produce mobility statistics--the extent of entry and exit (Baldwin and Gorecki, 1989), the amount of market share exchange in the continuing firm population (Hymer and Pashigian, 1962), the extent of rank change (Joskow,1960), the degree to which market shares regress toward the mean (Gort, 1963; Prais, 1976) and the extent of inter-group mobility (Prais, 1955).

Just as there are numerous mobility measures, there are many concentration statistics (Curry and George, 1983). Some are meant to capture several aspects of the size distribution--both the number of firms and the inequality in firm size. Others focus on select aspects of the distribution.

The multiplicity of mobility and concentration measures complicates an investigation of the relationship between the two. Since both concentration and mobility have been represented with a large number of summary statistics, choice of any one measure for the analysis is arbitrary. The results of the investigation may be sensitive to the particular measure chosen. This problem can be avoided if the measures are considered as a whole and the relationships between the two groups are then investigated.

While consideration of a set of concentration and mobility statistics avoids possible bias arising from an arbitrary selection of only one measure, it may founder on another criterion, that of comprehensibility. The complexity involved in the joint consideration of a set of variables may obscure the relationships between key variables. This problem can be overcome by establishing how many key dimensions exist in each data set and then by delineating the relationships between the different principal dimensions.

The first requirement is to ascertain whether the different measures of concentration and mobility capture related or unrelated dimensions of the same phenomena. In order to resolve this issue, a two step procedure is followed. The first step is to measure the primary dimensions of each set of measures--or to reduce those dimensions with the appropriate statistical technique. To do so, principal component analysis is used to ask how many significant but unrelated dimensions exist in each data set and to interpret each of the major dimensions in terms of the original variables.[3] The second step is to perform a principal component analysis on the concentration and mobility variables together, so as to examine whether the characteristics of the mobility set are captured, submerged, or otherwise overwhelmed by the principal components of the concentration statistics when the two are combined. If the mobility and concentration variables are weighted heavily in different components of the combined set of concentration and mobility statistics, then they possess different dimensions--the outside of the box is generally different from the inside. If, however, the mobility variables are subsumed under the concentration ones, then the inside of the box does not add much beyond that captured by the outside.

- Principal Component Analysis.

Principal component analysis provides a set of weights that, when applied to the original variables, creates a set of new variables that are orthogonal to one another, that exhaust the variance in the original set of variables, and that are hierarchically ordered in terms of their variance. Thus, the principal components (MOB_i) of a set of n mobility variables (m_i) are written as:

#1) $MOB_i = w_1*m_1 + ... + w_n*m_n$

and the set of principal components (CON_i) of a set of k concentration statistics (c_i) as:

#2) $CON_i = r_1*c_1 + ... + r_k*c_k$

where w_i, i=1, , ,n and r_i, i=1, , ,k are the weights (the eigenvectors) that sum to one and that are applied to the original variables to create the new variables--the components.

The first principal component of each set is the linear combination of the original variables that maximally discriminates--has the largest variance--among the industries in the sample. Each succeeding component accounts for the largest sample variance possible subject to the constraint that it be uncorrelated with previous ones.

The principal component procedure is suited to analyzing a situation such as this, where a number of different but related measures of a phenomenon exist, and where a reduction in the dimensionality of the data set is required. Principal component analysis will determine how much independence there is in a data set. It also provides a measure of the ability of each of the independent components to discriminate--since the variance of a component is a measure of the extent to which industries differ in their score on that component. Maximal power to discriminate should not be confused, however, with maximal explanatory power. The linear combination of a set of concentration or mobility variables that maximizes differentiation may not be the same as the linear combination that correlates most highly with a criterion such as market performance.

- Applying Principal Component Analysis to Concentration and Mobility Separately

There are a large number of concentration indices that can be chosen for any study involving concentration. Some of these indices,like the four-firm concentration ratio, use only a select number of firms; others like the Herfindahl use information on all firms. The relevance of some of these indices can be related to specific assumptions about behavioural relationships among oligopolists (Cowling and Waterson, 1976; Dansby and Willig, 1979); or it can be derived from an axiomatic approach like that adopted by Hannah and Kay (1977).

Because the profession has not arrived at a consensus on the most desirable index, a large number of concentration statistics were calculated for the period 1970 and 1979 for 167 4-digit Canadian manufacturing industries. Some were chosen from the group known as comprehensive statistics--those that combine the dimensions of firm numbers and firm size

inequality in different ways. These include such indices as the Herfindahl, the Entropy, the Hall-Tideman, the Horvath, the Hannah and Kay and the top n-firm market share. Others were chosen from secondary measures that focus on single characteristics of the firm size distribution. The Gini coefficient or the variance of the log of firm size captures inequality. So too do measures that use number-equivalent estimates of the number of firms--the inverse of the Herfindahl or the Hannah and Kay numbers-equivalent divided by the actual number of firms in the industry. The marginal concentration ratio (the share of the firms from position 5 to 8) or the size of this group relative to the top 4 captures the extent to which competition from a secondary grouping may be important.

Preliminary investigation revealed that many of the major comprehensive concentration measures were capturing the same dimension.[4] This is surprising since so much effort has been devoted to generating additional measures of concentration; but it accords with the findings of Aaronovitch and Sawyer (1975) and Vanlommel et al. (1977). The various comprehensive measures do basically the same job in summarizing similar dimensions of the firm size distribution. As a result, only a subset of the available concentration measures was chosen for the analysis here.[5] The subset chosen includes the four-firm concentration ratio (CR4), the Herfindahl (HF), the marginal concentration ratio of the second foursome (MCR8), the size of the second foursome relative to the first four (REL84), the relative redundancy ratio based on the entropy index (RELRED), the relative firm-numbers ratio using the Hannah and Kay numbers-equivalent (RELNUM),[6] and the variance of the logarithm of firm size (VARS).[7]

For the analysis, six mobility measures were used. These were: market share turnover arising from entry and exit (TURNE), market share turnover arising from continuing firm growth and decline (TURNC); market share turnover arising from entry via acquisition and exit via divestiture (TURNM); the variability in rank change for firms in an industry, RANK;[8] the variance in growth rates for continuing firms (GROW); and the coefficient that captures the regression of market share toward the mean (REGSH). All mobility statistics were calculated at the 4-digit level by comparing the position of manufacturing firms in 1970 and 1979.[9] The concentration and mobility variables are defined in the glossary.

Since a principal component analysis generates new variables--the components--in decreasing order of importance, the extent to which a small number of components dominate the others can be used to evaluate how many important independent dimensions exist. The importance of each of the principal components for both the concentration and mobility variables is presented in Table 1 and graphed in Figure 1, where importance is defined in terms of the proportion of total sample variability accounted for by each.[10] When the concentration or mobility variables are highly correlated one with another, the first principal component of each set of variables will account for most of the sample variability and will dominate the other components.

The first component is much more important for the concentration statistics than for the mobility statistics. In the former case, it accounts for 54 per cent of total sample variance; in the latter case, it accounts for 29 per cent. The rate of decline of importance for the succeeding components is greater as well for the concentration statistics. There are, there-

fore, relatively few important orthogonal components captured in the various concentration statistics. The mobility variables, by way of contrast, offer a more diverse set of characteristics.

The eigenvectors derived from the principal component analysis are also presented in Table 1. The eigenvectors are the weights (the w_i and r_i in equations #1 and #2) that, when applied to the original variables, yield the principal components. A high eigenvector value for a particular mobility or concentration component indicates that a variable receives a heavy weight in this component. An examination of Table 1 permits the various components to be interpreted in terms of the original variables by identifying the variables with the highest weights per component.

The first concentration component is equally weighted on both the discrete and summary measures (CR4, HF), the relative measures (RELRED, REL84) and, to a lesser extent, the variance in firm sizes (VARS). This is the general component where high concentration and inequality matter. That the discrete measure CR4 is as important as the Herfindahl, which uses all firms' market shares, confirms the earlier findings of Aaronovitch and Sawyer (1975) and Vanlommel (1977) that the CR4 measure does as well--is weighted as heavily--as more elaborate but less accessible measures. The second concentration component represents situations where market shares of the top 4 and of the next foursome (MCR8) are large and where the relative numbers variable (RELNUM) is large--that is, where there is no tail of small firms. The third component represents situations where the second foursome (MCR8) is important and where there is a tail of small firms. The fourth component primarily weights inequality as measured by VARS.

These results indicate that there is more than one dimension to market structure. The most commonly used concentration statistics, like the four-firm concentration ratio and the Herfindahl, though meant to capture both the number of firms dimension and the inequality dimension, dominate but do not exhaust all the dimensions of the concentration data set. The ancillary components embody the importance of a second group of firms. In the past, these measures have been discounted, partially because there is always the danger that they capture the same phenomenon as the dominant measures. In a small economy, such as the Canadian, where the top eight firms often account for most of the market, the value of the market share of those firms in positions 5 to 8 might be posited to be just 100 minus CR4. That these alternate measures are included as separate components, orthogonal to the first, demonstrates that they represent a different dimension of market structure.

In contrast to the concentration components, the mobility components are not only more equal in importance, but are also easier to interpret since there are a small number of dominant variables in each component. The first component jointly reflects turnover that arises from entry and exit (TURNE) and change in the rank of continuing firms (RANK). The second component reflects turnover in the continuing sector (TURNC) and merger entry and exit (TURNM). The third component reflects merger turnover (TURNM) and regression to the mean (REGSH). The fourth captures variability in growth rates (GROW). The fifth represents turnover in the continuing sector (TURNC).

This is a rich set of characteristics describing intra-industry change. It confirms the oft-stated characterization of the competitive process as a complex phenomenon. The conventional tendency to summarize these aspects with a single summary statistic, like the concentration ratio, leaves the impression that the intensity of competition is unidimensional; or, that the various characteristics that describe the outcome of the competitive process must be closely correlated across industries--that industries where there is greenfield entry are also those where the market shares and the relative ranks of incumbents are unchanging. The orthogonality of these different dimensions demonstrates this is not the case. An accurate characterization of the range of outcomes of the competitive process requires a multiplicity of statistics describing intra-industry change.

- Applying Principal Component Analysis to a Combined Data Set of Concentration and Mobility Statistics

Whether the mobility and concentration measures capture different dimensions of the same phenomenon can be answered by performing a principal component analysis jointly on both sets and by investigating the pattern of interdependence among the original components, noting which of the original concentration and mobility components appear together in the combined set. The eigenvectors associated with this exercise are presented in Table 2. Examination of the eigenvectors indicates that the mobility measures are not completely subsumed into the concentration components. The only exception is the first component of the combined set that includes both CON_1 (the main concentration component) and MOB_1 (the entry and exit component). Concentration and turnover from entry and exit are closely related.

The remaining components of the combined data set are basically one of the original components of either the concentration or the mobility data set, with a few variables from the other set added. In order, the combined principal components two through seven basically are CON_2, MOB_2, CON_3, MOB_3, MOB_4, and MOB_5. Where new variables are added to one of the original components, the additional information corroborates or extends, in a sensible manner, the original interpretation placed on the component. For example, the continuing firm turnover and merger turnover component of the mobility data set, MOB_2, is combined with MCR8 in the third component, when the concentration and mobility measures are merged together for the analysis. The importance of having a second tier of large firms, then, is an important structural attribute of those situations where continuing firm turnover is large. The second tier concentration component, CON_3, weighting primarily MCR8, is combined in the fourth joint component with the mobility variables GROW and REGSH. Larger variance in growth rates associated with regression toward the mean is accompanied by the existence of a larger market share for the second foursome.

This confirms that the primary relationship between structure and mobility can be found in the inverse relationship between concentration and the extent of entry and exit. The other important dimensions of mobility are not closely related with the main or primary dimension of concentration. Rather they are related to structural measures that have received a secondary emphasis in the literature--measures that capture the importance of a second tier of firms. Finally, the fact that, for the main part, concentration and mobility have separate dimensions confirms that there are enough cross-sectional differences in the concentration

and mobility measures that the use of both is warranted for exercises that attempt to classify industries on the basis of potential and actual competitiveness.

II) The Relationships Between Concentration and Mobility Measures

- Canonical Correlation Analysis

In the previous section, it was demonstrated that concentration and mobility statistics are on the whole sufficiently different to suggest that both need to be used to describe structure; nevertheless, it would be incorrect to claim that there was no relationship between the two. This section more directly investigates the nature of these relationships.

Principal component analysis is designed to establish the dimensionality of the data set; but it creates variables for each data set with no concern as to whether they are related across the sets. It is, therefore, not as well suited for describing the between-set relationships; they have to be inferred from the weights attached to the variables in each set that make up the components.

An alternate manner of reducing the dimensionality in both the concentration and mobility statistics and of investigating the relationship between the two is to perform a canonical correlation analysis. Canonical correlation analysis, when performed on the concentration and mobility statistics, finds weights for each of the concentration statistics and then for each of the mobility statistics that create pairs of new variables (the canonical correlates)--one associated with each data set, CANCON and CANMOB. These variables are correlated with themselves, but not with other pairs of correlates. The canonical correlates ($CANMOB_i$) of a set of n mobility variables (m_i) are written as

#3) $CANMOB_i = y_1*m_1 + ... + y_n*m_n$

and the canonical correlates ($CANCON_i$) of a set of k concentration statistics (c_i) as:

#4) $CANCON_i = z_1*c_1 + ... + z_k*c_k$

where y_i, i=1, , ,n and z_i, i=1, , ,k are the weights applied to the original variables to create the new variables--the correlates. The correlations between corresponding pairs of the canonical variables form a decreasing sequence--that is, the first canonical variable has the highest correlation, the second has the second highest.

Canonical correlation analysis is better able to depict relationships across data sets than is principal component analysis, but is less able to define the dimensionality within each data set. An additional advantage of canonical correlation analysis is that significance tests are available to judge whether the nth and succeeding pairs are significantly related. When they are not, the relationships can be disregarded.

- Applying Canonical Correlation Analysis

The canonical correlation analysis was performed twice--first, on the principal components that were generated from each of the concentration and mobility data sets and then on the original variables.

When canonical correlation analysis was performed on the principal components of each data set, three pairs of canonical variables were produced where the correlation between each pair ($CANMOB_i$, $CANCON_i$) is significantly different from zero. The first set primarily links CON_1 to MOB_1 and inversely relates the principle dimension of concentration to the entry component. Once more, this emphasizes the importance of the connection between industry structure and entry. The second set primarily relates CON_2 and MOB_6. The third set links CON_3 and MOB_4, or MCR8--the importance of the second foursome--to GROW--the variance in growth rates of continuing firms.

It should be noted that while some linkages between the principal components of the concentration and mobility statistics do exist, only in the case of the first canonical correlate are the most important components linked. This confirms that the two sets generally contain different dimensions.

While using the principal components as input to the canonical correlation analysis serves to illustrate how the separate orthogonal dimensions within each of the two data sets are related across sets, the relationship between the original variables has to be inferred indirectly when working at the level of the principal components. These inferences may miss links that can only be ascertained after following a complex path which sometimes crosses two or more principal components.

To overcome this potential problem, the canonical technique was also applied directly to the underlying variables. Once more, three significant sets of canonical variables were generated and the correlation coefficients between each of the canonical variables and the original variables in the two data sets are presented in Table 3. The first set inversely relate the most popular concentration indices (CR4 and HF) as well as several others (VARS, REL84) to turnover from greenfield entry and exit (TURNE) and rank change (RANK). The second set relate the secondary concentration measures (MCR8, RELNUM) to entry (TURNE), continuing firm turnover (TURNC), variability of growth rates (GROW) and rank change (RANK). The third set relate marginal concentration (MCR8) to continuing firm turnover, turnover from merger entry and exit, and variance in growth rates--TURNC, TURNM, and GROW, respectively.

These results confirm the dichotomy that emerged in the principal component analysis between the traditional measures of concentration and the tertiary measures that focus on the importance of a second tier of firms. The most important dimension of concentration is related closely to only two of several equally important mobility measures--the variable that captures the extent of greenfield entry and closedown exit and the amount of rank change in the continuing firm population. The other dimensions of mobility are related to the secondary measures of concentration that capture the number and importance of firms

outside the top four firms. The canonical correlation analysis shows that various measures of the importance of a secondary group of firms (MCR8, RELNUM) are related to internal conditions of competition--the extent to which there is continuing firm turnover (TURNC) and variability in growth rates (GROW).

Concentration has traditionally been explained by technical factors relating to plant and multiplant scale effects. Those who stress that the type of competition has an important effect on structure have generally had only theoretical models to make their case. The results of the principal and canonical correlation analyses suggest that concentration and mobility are related in the way that some stochastic growth models would suggest. The most important dimension of concentration is negatively related to the entry and exit dimension of mobility. This is the relationship that emerges from the model proposed by Simon and Bonini. Not only does this suggest that at least some aspects of the outside of the box can be related to the dynamics of the competitive process, but it strongly points to entry as the most important correlate of structure.

ON THE INSIDE LOOKING OUT: THE INFLUENCE OF MOBILITY ON CONCENTRATION

Until now, this paper has investigated whether a clear and uncomplicated relationship between market structure and mobility exists. While a connection is found, it is not so straightforward that the concentration index can be used to describe meaningfully the type and variety of change that is going on within an industry. On the other hand, the results of both the canonical correlation and principal component analyses suggest that focusing on the opposite relationship may be of more value. The questions that have been posed to this point are in keeping with the traditional approach with its emphasis on the causal relationship flowing from structure to intensity of competition. An alternate approach is to ask whether the position of economists like Simon and Bonini is correct. Rather than ask whether concentration serves to describe the intensity of competition, the question of how the nature of competition affects concentration can be addressed.

I) The Determinants of Concentration: A Framework

- Concentration Levels

A number of theories have been proposed to explain the level of concentration in an industry. These can be divided into two groups. The first group sees concentration as a reflection of technical production characteristics, such as entry barriers, scale and scope economies. One variant of this first group has been dubbed the technological explanation, in which concentration is a function of the minimum efficient sized plant (Davies and Lyons, 1982). This explanation does not always provide a point estimate of the level of concentration, but instead gives a lower bound for it. In the case of the technological explanation using plant scale economies, the lower bound for CR4 is 4 times the ratio of the minimum efficient sized plant divided by market size.

The second set of explanations model the workings of the competitive process by the use of stochastic processes, which in turn lead to predictions that the degree of concentration will be a function of the amount of mobility in an industry. They generally are based on a

stochastic growth model. One variant starts with a version of Gilbrat's Law or the Law of Proportionate Effect (LPE)--that all firms, irrespective of their size, have the same probability of growing or declining. The application of this law to a given population of firms will result in ever increasing inequality in firm sizes.

Since concentration does not appear to be trending upward without limit, various mechanisms have been introduced to slow the ever increasing tendency for concentration to rise as a result of the application of the LPE. These methods force the inside of the box to be congruent with the outside. For example, Prais (1976, pp.34-39) relies on the concept of a regression to the mean in firm sizes to offset the LPE. The evidence presented in Baldwin and Gorecki (1989) suggests such a regression exists for firms in the Canadian manufacturing sector. A second approach has been taken by Simon and Bonini (1958). In their model, the LPE applies only to firms above MES, where it is assumed that costs are constant. The particular mechanism that prevents ever increasing concentration is entry just above MES. The greater the degree of entry, the lower is the equilibrium level of concentration. This process is also at work in Canada since, as was shown in Baldwin and Gorecki (1987, 1990a), entry and exit are of substantial importance.

The technological and the stochastic theories of concentration are not incompatible. It is possible to argue that technical considerations provide a lower bound for concentration but that the nature of stochastic processes then influences the degree to which the actual level of concentration exceeds these bounds. The extent to which both these explanations are compatible with observed levels of concentration in the Canadian manufacturing sector is the subject of the next section.

II) The Determinants of Concentration: The Evidence.

In the previous sections, clear evidence of the empirical relationship between mobility and structure emerged. This section examines whether this relationship adds anything to the explanation of concentration that technical considerations do not.

Choice of the form of equation to be used to estimate the determinants of concentration offers particularly difficult methodological problems. On one hand, a tightly formulated model can be formulated and tested. On the other hand, only a loose structure can be used. The former has the advantage that it is elegant; it has the disadvantage that reality has to be so simplified that the model cannot be expected to fit exactly for a broad cross-section of industries.

The simplest model is that posited by Simon and Bonini. If the growth and decline of all firms above a certain minimum--dubbed the MES--follows the law of proportionate effect and new firms are born into the smallest size class at a constant rate, then the firm size distribution will take on a skewed distribution that, in its upper tail, can be approximated by a Pareto distribution with parameter r where

#5) $r = 1/(1-a)$

$a = G_n/G$ and

G_n is the part of net growth G due to new firms

This expression provides a direct and testable hypothesis of the relationship between a parameter that measures the size distribution and the rate of entry.

Simon and Bonini (1958) test this relationship for the U.S. by calculating "r" from the firm size distribution and "a" from entry data and found that the two point estimates were quite similar. Davies and Lyons (1982) indirectly test this relationship for the U.K. by transforming it to one between the four-firm concentration ratio and several other variables--the Pareto parameter "r", the ratio of the amount of suboptimal capacity and others. They also report evidence that suggest the Simon and Bonini model has some validity.

The relationship was tested directly for the Canadian manufacturing sector. An estimate of "a" was obtained by measuring the size of all those entrants between 1970 and 1979 that were still extant in 1979 and dividing this by industry growth between 1970 and 1979. The parameter "r" was estimated from the firm size distribution by dividing the mean size of all plants above the plant size that just accounts for 50 per cent of employment by the latter. This is equal to a/(a-1)-- Davies (1980). The median value of the Pareto parameter was 1.69. The median value of the right hand side of equation #5 , based on entrants' market share, was 1.20.[11] These are significantly different from one another. Moreover, the correlation between the two, across 167 industries, was only .004 and insignificant.

The failure of the Simon and Bonini model, as it is specified here, is to be expected. It is clear that the model was not meant to apply everywhere. In the first case, not all Canadian industries satisfy Gilbrat's law. In some, there is a very significant regression toward the mean. Secondly, the particular variant of the model that results in equation #5 was derived for the situation where there is positive growth in the economy. Only 80% of Canadian 4-digit manufacturing industries had positive growth in real output in the 1970s.

Given the variety of competitive conditions that exist in an industry, it is unlikely that any single model can be found that applies across all industries and that is empirically tractable. Therefore, a technique was adopted that is more in keeping with the existing literature on the causes of concentration. Correlates of concentration were examined using a set of predetermined instruments that, a priori, should affect concentration.To this end, concentration was regressed on a number of the previously described mobility statistics and a set of variables that represent the degree to which scale economies at the firm and plant level might influence the level of concentration. The estimated equation is

#6) Conc = f(Mobility, Scale)

In this analysis, the four-firm concentration ratio is used as dependent variable since it is heavily weighted in both of the first two principal components of market structure. It is measured as of 1979. At issue is the extent to which it is explained by technical factors as of 1979 or by mobility characteristics measured over the previous ten years. The same mobility variables used previously, were employed once again--with the exception of turnover due to mergers.[12]

Many previous analyses of the determinants of concentration have suffered from a number of important conceptual and measurement problems. As Caves et al. (1980, pp.41-3) point out, the four-firm concentration ratio is just the product of three terms--the ratio of 4 divided by the number of firms; the ratio of the average plant size of the top 4 to the industry average plant size; and the multiplant activity of the top 4 relative to the industry average multiplant ownership. If CR4 is regressed on variables that are proxies for these three terms, the resulting relationship will be close to an identity. This problem is not solved by using only one of the proxies, since the regression coefficient on this variable will then represent only a weighted average value of the omitted variables. Nevertheless, this is what a large number of studies of the determinants of concentration have done.[13]

The scale variable that is commonly used involves an estimate of the minimum efficient plant size. Typically this is not measured by some best practice engineering estimate; rather it comes from the size distribution of plants. One such widely used proxy is the average size of the larger plants accounting for 50 per cent of industry employment divided by market size. Yet this is likely to be identical or very closely related to one of the three terms above. In a country like Canada, the average size of the top 50 per cent of all plants is closely related to the average size of the plants of the top 4--for 1979 the correlation at the 4-digit level between these two was 0.9862. Thus, using this term is equivalent to using a variable that is part of the concentration identity. CR4 is just 4 times this scale proxy times the number of plants per firm in the top 4 and the coefficient attached to this variable, when it is regressed on concentration, is just a weighted average of the number of plants owned by the four largest firms. Davies (1980, p. 287) observes that such MES proxies are "better interpreted as measures of concentration". Finding a close relationship between CR4 and this proxy for scale economies does not provide evidence of the importance of scale economies.

Davies and Lyons (1982) have pointed out a second problem in using the average size of plants accounting for the top 50 per cent of sales divided by market size to proxy scale effects. When the plant size distribution is Pareto, this proxy variable reduces to a function of the coefficient characterizing the Pareto distribution. Thus the proxy for scale is just a measure of inequality. Finding a regression relationship between CR4 and this variable only confirms that inequality and concentration are both related--as the principal component and the canonical correlation analyses have already shown. It does not demonstrate the extent of the connection between concentration and scale effects.

Independent evidence of the extent of scale economies is required. Four are used here. The first (SCALE) is an estimate of the extent of scale economies at the plant level that was derived from the estimate of a production function using plant level data for each of the 167 4-digit manufacturing industries.[14] The second is an estimate of the branching minimum efficient sized plant divided by market size (BMES). The problems with the use of an MES estimate that is based on the average size of larger plants are overcome by directly estimating the minimum efficient sized plant. In order to do so, Lyons (1980) method is employed. This uses information on the size at which firms begin to build a second plant to infer the size at which plant economies are exhausted.[15] The third is a variable that measures the cost disadvantage of small plants (CDR).[16] It is the ratio of value-added per worker in small

plants relative to large plants. Finally, the capital/labour ratio (KL)[17] is employed as a proxy for the extent to which scale economies are likely to be important.

Several variables that proxy the determinants of multiplant operations and, therefore, of firm economies were also included. These were advertising (ADV), and research and development intensity (RD).[18]

The different variables used for scale effects were sufficiently correlated that they all appear to be capturing a similar phenomenon. While they were not related closely enough that all but one could be discarded, the interrelationships were sufficiently high to mean that the separate effects were not readily disentangled. Therefore, the regression was performed in two steps. In the first stage, all variables were included. In the second, a principal component analysis was performed separately on the scale variables and on the mobility variables and the resulting principal components from each set were then used as regressors for CR4.

When all variables are included in their original form, both mobility and scale variables are significant, as the estimates in equation #1 of Table 4 indicate. High mobility from entry and exit (TURNE), continuing firm turnover (TURNC), and rank change (RANK) are all associated with lower concentration. While all of the plant scale effects have positive and significant correlations with CR4, only BMES and the capital-labour ratio (KL) are significant when all scale variables are included together in the regression. This is the result of multicollinearity between the scale variables.

In order to overcome this, principal components for each of the mobility and scale variables were generated (MOB_i and SCL_i, respectively) and then used in the regression.The components are presented in Table 5; the regression coefficients in Table 6. The regression results, using the principal components, demonstrate that more than two dimensions of scale matter. The first, second, third and fifth components of the plant scale coefficients are all significant; SCALE and CDR weigh heavily in these components--in addition to BMES and KL. Moreover, the research and development variable (RD) is also important.

The regression with all the variables included accounts for about 64 per cent of the variation in the values of the four-firm concentration ratio across the 162 industry sample used. This is a substantially better fit than previous attempts to 'explain' the cross-sectional variation in Canadian concentration that have relied on scale-related measures alone.[19] The mobility and the scale variables as a group were about equally important in the regression done here. Omitting all of the mobility or the concentration variables reduced the coefficient of determination to 47 and 35 per cent, respectively.

While this is suggestive that both mobility and scale effects are important, it is not conclusive. For the stochastic theories of market structure may have as their foundation, explanations of differences in turnover that are related to technical characteristics of an industry. For instance, the existence of scale economies may lead to considerable turnover as some firms find the correct strategy that allows them to exploit these economies, move down the cost curve and gain market share while the less successful fall further and further behind. If this or a similar explanation of the relationship between turnover and scale is correct, some of

the explanatory power of the mobility statistics really lies in the scale effects. In order to test this, the principal components were calculated for the mobility and scale variables together (Table 7) and the components were used as regressors. The regression results are reported in Table 6.

There was very little overlap between the components of the original two sets. On the whole the components that were visible by themselves are still separate components of the combined set.[20] This indicates that the two explanations of concentration are complimentary rather than competing hypotheses. That is not to say there are no links between the two. The first joint component contains the first mobility component (low entry) but also is characterized by scale economies; the third joint component is basically the second scale component (a high weight for BMES) but inversely weights continuing firm turnover. The fifth joint component is the fourth scale component (advertising) and also is positively related to the amount of regression to the mean in firm market shares.

The regressions using the joint components produce the same qualitative results as previously in that both the mobility and scale components matter. The joint components that are significant are the first, third, fifth, ninth and eleventh. They represent MOB1, SCL1, SCL4, SCL5, and MOB5. Low entry leads to lower concentration. Scale effects, which are accompanied by high MES relative to market size, lead to higher concentration.

Until now, the problem of simultaneity has been ignored. The hypothesis being tested is the extent to which the underlying mobility and scale characteristics determine concentration. That mobility and entry characteristics determine concentration is contrary to the long-standing position taken by traditional structuralists. The structure-conduct-performance tradition emphasizes that entry and mobility are likely to be affected by structure. The possible effect of simultaneity on the coefficients estimated here needs to be considered.

In order to do so, a two-stage least squares regression was employed. The various exogenous variables in the larger set of regressions that determined both concentration, entry and exit, and internal mobility were used as instruments on both TURNE and TURNC, the two variables that were posited to be endogenous. Variables chosen as exogenous were the industry growth rate, the variability of the growth rate, a regional dummy variable, a producer goods dummy variable, foreign ownership, imports, and the comparative advantage of an industry. The exogenous variables were transformed into principal components. The SCALE variables used before were again assumed to be exogenous. The results of the equation that uses this technique are also reported in Table 4. It is evident that the entry and exit variable is still significant.

It may, therefore, be concluded that both theories of market structure are relevant. Scale economies have an undeniable effect on the extent of market structure; but the amount of firm turnover, whether it be from entry and exit, or from continuing firm growth and decline also has an impact.[21]

- Changes in Concentration

The analysis of the determinants of concentration was taken one step further by examining changes in concentration. Concentration, like firm size, exhibited a tendency to regress towards the mean during the 1970s. In Figure 2, the 167 4-digit manufacturing industries are ranked on the basis of their 1970 concentration ratio and divided into 7 equal sized groups. The average change in concentration is also included. It is evident that concentration increased in industries with low levels of concentration in 1970. Those with high levels decreased concentration on average over the decade.

It is also the case that industries below the top were increasing concentration and those above the bottom were decreasing concentration. Figure 3 ranks industries on the basis of 1979 concentration values and graphs the average 1979 values and the average change [C(t) - C(t-1)]. Industries that are in the low end of the concentration spectrum in 1979 on average decreased their concentration since 1970. Those in the high end increased it.

Previous attempts to take into account the simultaneous nature of the structure-conduct-performance literature also have considered concentration to be endogenous (Martin, 1979; Geroski, Masson and Shannon, 1987) In the latter, the concentration equation was specified as

#7) $C(t) - C(t-1) = L * [(C_o) - C(t-1)]$

that is, the change in concentration is posited to follow a partial adjustment process with parameter L where $C_o - C(t-1)$ is the difference between the permanent or equilibrium level of concentration and last period's value of concentration. Using this formulation, the previous studies have produced an estimate of the adjustment parameter that is quite small. Martin (1979) and Geroski et al. (1987) report estimates around 10 per cent over a five year period. These imply a long period of adjustment.

The plausibility of this finding depends partially upon an evaluation of whether structure adapts slowly or quickly to change in its underlying determinants. If technical considerations are the main determinants of concentration, it is not inconceivable that change is slow. New plants that take advantage of newer technology often have a considerable gestation lag and, therefore, structure might be expected to adapt rather slowly. This was indeed the result which was obtained when equation #7 was estimated using the 1979 and 1970 concentration ratios for the Canadian manufacturing level at the 4-digit level and the predicted long-run concentration values from equation #6 for C_o. The estimated value of the adjustment parameter was .38 with a standard error of .11.

Before the previous results are accepted as indicating a slow adjustment process, it is important to note that there are statistical reasons that suggest these results need to be treated cautiously. There is an error-in-variable problem arising in the course of estimating equation #7 that will bias the estimated adjustment coefficient downward.

The main reason to expect a measurement error in the regressor is that the estimate of the long-run equilibrium level towards which the system is adjusting C_0 must contain an error as it is estimated from a regression. The standard formula for bias in the face of measurement error for a two variable regression indicates that the estimated adjustment coefficient "L", derived from equation #7, will be biased downward. Less than instantaneous adjustment will be suggested even when adjustment is almost immediate. The percentage bias is given approximately by the ratio of the error variance in the regressor divided by the variance of the observed regressor.

Two methods were chosen to overcome the problem arising from the measurement problem. Since actual change is not subject to measurement error and the long-run change is, the reverse regression should provide an unbiased estimator of the inverse of the adjustment coefficient. This yielded an estimate of .84 with standard error of .12. This is not significantly different from one.

The second method is to choose an instrument that is correlated with the true long term change and not with the error in measurement. An instrumental variable using the rank of the dependent variable is commonly used to correct for the errors-in-variable problem. It is useful only if the error is not correlated with the rank of the observation. It is doubtful that this is the case here.

The nature of the adjustment process can be seen in Figure 4, which graphs the mean value of the required long-run change--[C_0 - C(t-1)]--and the actual change--[C(t) - C(t-1)] between 1970 and 1979 for industries ranked on the basis of the required change and grouped into seven categories. The average value of concentration in 1970 for each group is also presented. Both predicted and actual change show that there is a regression to the mean phenomenon taking place. The greatest increase in concentration occurs in industries with low values of concentration in 1970. The greatest decrease in concentration occurs in industries with the highest levels of concentration in 1970. In both cases, the actual change in the tails of the distribution--[C(t) - C(t-1)]--is much less than that required to reach long-run equilibrium [C_0 - C(t-1)].

The reverse regression suggests that there is really no significant difference in the actual change and the change required to reach long-run equilibrium. On the basis of Figure 4 then it would appear that the error in [C_0 - C(t-1)] is larger for larger values of this variable and that the error is also likely correlated with C(t-1). The rank of both variables, therefore, is likely to be unsuitable for use as an instrument. On the other hand, the rank of the actual change (C(t) - C(t-1)) is likely to be related to the true variable and less correlated with the error and may, therefore, provide a suitable instrument. In order to evaluate this possibility, the data were ranked on the basis of the actual change in concentration in Figure 5 and grouped into seven classes. Both the average actual change and the average long-run change are graphed along with the average 1970 concentration class.[22] There is much less of a difference between the two series when the grouping is done on the basis of the actual change. A regression that uses the rank of the actual change in concentration yields a coefficient of adjustment of 1.16 with standard error .17. The coefficient of adjustment is not significantly different from one. Alternately, using the rank of C(t)- C(t-1) to divide the sample into three

groups, removing the middle group and then using the means of the samples in the two tail groups to calculate the adjustment parameter produces an estimate of 1.11.[22]

In summary, the evidence suggests that change in the outer shell of the box called market structure follows the same stochastic pattern that firm growth does. There are both centripetal and centrifugal forces at work. It is also probable that the changes in structure that are required by changes in basic conditions are fully encapsulated in market structure within the decade. Market structure is relatively stable compared to mobility measures -- but what changes are warranted are brought about fairly quickly.

CONCLUSION

Entry and exit and other aspects of mobility have been generally ignored in favour of structural measures such as concentration statistics. There are several reasons for this. The first is that concentration was regarded as a reasonable proxy for the intensity of competition within an industry. Unfortunately, concentration statistics are very imperfect proxies for this purpose. Concentration measures perform poorly as predictors of the intensity of competition for several reasons. First, since they approximate the size distribution of firms and the size distribution changes slowly, they suggest little intra-industry change is occurring over time whereas, in reality, there is a great deal of intra-industry change. Secondly, concentration statistics do a poor job of ranking industries on the basis of the amount of change going on inside those industries. This is primarily due to the fact that there are many dimensions of competition. Inter alia, these dimensions include the extent to which firms change ranks, larger firms regress toward the mean, entry and exit is important, and whether much market share is redistributed among continuing firms. Concentration is related more closely to some of these dimensions than others. That concentration by itself does poorly as a proxy for the intensity of competition does not mean it should be discarded. In conjunction with mobility variables, it can provide a useful guide as to industries where competition authorities might best focus their attention.

The second reason that mobility statistics have tended to be ignored is that entry, exit and other aspects of intra-industry change have been regarded as important only in the case of disequilibrium phenomena. When fundamental characteristics related to scale economies change, then entry and exit occur as an industry moves from an old to a new market structure. In this view, inter-industry differences in measures like market share turnover do not reflect quasi-permanent differences in the intensity of the competitive process but involve a reaction to exogenous phenomenon that requires adaptation of one equilibrium to another.

This view is incorrect. It is true that changes in structure are associated with net entry or exit and with large firms gaining or losing market share. But it is also true, as the school of stochastic growth theorists hypothesized, that the causal relationship flows from mobility to concentration. It is clear from this paper that the failure of concentration to rank industries as precisely as do each of several mobility measures taken separately does not mean that there is no relationship between concentration and mobility. Taken together, the various dimensions of mobility, along with technical characteristics relating to the importance of scale, serve to predict concentration quite well.

Mobility measures, then, take on a significance for two reasons. Their importance does not depend on either acceptance or rejection of the structure-conduct-performance paradigm. The evidence presented indicates that mobility statistics are important determinants of the box that is used to describe industry structure. They are also independent estimates of the degree of market rivalry that is taking place within industries and offer an important complement to structural characteristics.

While mobility statistics are a powerful tool for analysis, they will not always be available. Measures of market structure will continue to be used in these circumstances. This paper also provides a guide for this practice. It demonstrates that when structural measures are being sought to proxy the internal competitive conditions, candidates from at least two different sets should be used. The first should come from the set of comprehensive measures that concentrate on the importance of the largest firms--such as the four-firm concentration ratio, or the Herfindahl. This measure will capture cross-industry differences in the extent of entry and exit. A second concentration statistic should also be chosen from those measures that capture the importance of a second tier of firms--such as the share of those firms from position 5 to 8. It is more closely related to inter-industry differences in turnover within the continuing firm population.

VARIABLE LIST

MEASURES OF CONCENTRATION (based on shipments)

HF--Herfindahl measure-the sum of squared markets shares (S_i) of all firms classified to the industry.

CRi--top firm market share-the sum of the top i firms' market shares, based on domestic production.

ENT--the entropy measure--($- S_i \ln(S_i)$).

REDUND--the entropy based redundancy statistic--(lnN-ENT)-varies from 0 to lnN.

HAN(a)--Hannah and Kay's (1977) numbers-equivalent measure--$\mathrm{Sum}[s_i^a]^{1/1-a}$.

RELNUM(I)--the firm numbers-equivalent Hannah and Kay measure using the parameter i divided by the number of firms in the industry.

MCR8--the share of the firms ranked from 5 to 8.

VARS--the variance of the logarithm of firm shares.

MEASURES OF MOBILITY

- Entry and Exit

SH23--the long-run rate of firm entry accomplished via the building of new plants. It is defined as share of 1979 shipments in plants of firms that entered the industry between 1970 and 1979 by building new plants.

SH22--the long-run rate of firm entry via the acquisition of plant. It is defined as the share of 1979 shipments belonging to firms that entered between 1970 and 1979 by acquiring plants.

SH34--the long-run rate of firm exit resulting from plant closure. This is the share of 1970 shipments in plants of firms that left the industry between 1970 and 1979 because of plant closure.

SH31--the long-run rate of firm exit via the divestiture of plant. It is defined as the share of 1970 shipments in plants of firms that are to exit the industry by 1979 because of divestiture.

- Measures of Share Change (based on shipments)

RANK--the standard deviation of the ratio of the rank of the continuing producer in 1979 to that in 1970.

TURN--the sum of the absolute values of the differences between the shares in 1979 and 1970 divided by 2. Note that these share changes are calculated as if no mergers occurred.

TURNE--the sum of SH23 plus SH34 divided by 2.

TURNC--TURN minus TURNE

TURNM--the sum of SH22 plus SH31 divided by 2.

- Differential Growth Rates (based on shipments)

GROW--the variance in the growth rates of firms in the industry in 1970 and 1979

Measures Derived from Regressions of 1979 Share on 1970 Share (shipments)

CORSH--the correlation between initial and final year share.

REG--the coefficient from regressing final year on initial year share.

REGSH--REG divided by CORSH -- see Gort(1963).

MEASURES OF SCALE

SCALE-the sum of the coefficients of a Cobb-Douglas production function for 1979. See Baldwin and Gorecki(1986).

MES-the Lyons(1980) estimate of MES divided by industry shipments.

CDR-the cost-disadvantage ratio, defined as value added in smaller divided by larger plants where the dividing line between small and large plants is the 50% shipment value.

KL-the capital labour ratio, defined as the ratio of gross capital stock in 1971 divided by wage and salary earners for that year.

REFERENCES

Aaronovitch, S. and Sawyer, M.C., 1975. Big Business: Theoretical and Empirical Aspects of Concentration and Mergers in the U.K. Macmillan: London

Baldwin, J.R. and P.K. Gorecki. 1986. The Role of Scale in Canada-U.S. Productivity Differences in the Manufacturing Sector, 1970-1979. Toronto: University of Toronto Press.

Baldwin, J.R. and P.K. Gorecki. 1987. "Plant Creation versus Plant Acquisition: The Entry Process in Canadian Manufacturing." International Journal of Industrial Organization. 5: 27-41.

Baldwin, J.R. and P.K. Gorecki. 1989. "Measuring the Dynamics of Market Structure." Annales d'Economie et de Statistique. 15/16.

Baldwin, J.R. and P.K. Gorecki. 1990a "Firm Entry and Exit in the Canadian Manufacturing Sector 1970-82." forthcoming Canadian Journal of Economics

Baldwin, J.R. and P.K. Gorecki. 1990b "Measuring Entry and Exit to the Canadian Manufacturing Sector: Methodology." forthcoming in A.C, Singh and P. Whitridge, (eds.) Analysis of Data in Time. Proceedings of a Conference sponsored by Statistics Canada, Carleton and Ottawa University, fall 1989.

Baldwin, J.R. and P.K. Gorecki. 1990c. "Concentration Statistics as Predictors of the Intensity of Competition." Research Paper #23g. Analytical Studies Branch, Statistics Canada.

Baldwin, J.R. and P.K. Gorecki. 1990d. "Intra-Industry Mobility in the Canadian Manufacturing Sector," Research Paper # 23b. Analytical Studies Branch, Statistics Canada.

Caves, R.E., M.E. Porter, A.M. Spence, with J.T. Scott. 1980. Competition in the Open Economy: A Model Applied to Canada. Cambridge, Mass.: Harvard University Press.

Curry, B. and K.D. George. 1983. "Industrial Concentration: A Survey." Journal of Industrial Economics 31: 203-55.

Dansby R.E. and R. D. Willig. 1979 " Industry Performance Gradients." American Economic Review. 69: 249-60.

Davies, S.W. 1980. "Measuring Industrial Concentration: An Alternative Approach. "Review of Economics and Statistics 62: 306-9.

Davies, S.W. and B.R. Lyons. 1982. "Seller Concentration: The Technological Explanation and Demand Uncertainty." Economic Journal 92: 903-919

Geroski, P.A., R.T. Masson, and J. Shaanon. 1987. "The Dynamics of Market Structure." International Journal of Industrial Organization 5: 93-100.

Gort, M. 1963. "Analysis of Stability and Change in Market Shares," Journal of Political Economy. 62: 51-61.

Harris, R.J. 1975. A Primer of Multivariate Statistics. New York: Academic Press.

Hymer, S. and P. Pashigian. 1962. "Turnover of Firms as a Measure of Market Behavior," Review of Economics and Statistics 44: 82-87.

Ijiri, Y. and H. Simon. 1977. Skew Distributions and the Sizes of Business Firms. Amsterdam: North-Holland.

Joskow, J. 1960. "Structural Indicia: Rank-Shift Analyses as a Supplement to Concentration Ratios," Review of Economics and Statistics 42: 113-116.

Krause, W. and J. Lothian. 1988. "Measurement of and Recent Trends in Canada's Level of Corporate Concentration." Paper presented at the American Statistical Association Conference, New Orleans, August.

Lyons, B.R., 1980. "A New Measure of Minimum Efficient Plant Size in U.K. Manufacturing Industries." Economica 47: 19-34.

Martin, S., 1979. " Advertising, Concentration and Profitability." Bell Journal of Economics 10: 639-47.

Prais, S.J. 1955. "Measuring Social Mobility." Journal of the Royal Statistical Society Series A. 118: 56-66.

Prais, S.J. 1976. The Evolution of Giant Firms in Britain. Cambridge: Cambridge University Press.

Scherer, F.M. 1980. Industrial Market Structure and Economic Performance. Second Edition. Chicago: Rand-McNally.

Schmalensee, R. 1988. "Industrial Economics: An Overview." Economic Journal 98: 643-81.

Simon, H.A. and Bonini, C.P., 1958. "The Size Distribution of Business Firms." American Economic Review 48: 607-17. (Reprinted in Ijiri and Simon (1977)).

Vanlommel, E,B. de Brabander and D. Liebaers. 1977. "Industrial Concentration in Belgium: Empirical Comparison of Alternative Seller Concentration Measures." Journal of Industrial Economics 26: 1-20.

Yamey,B. 1985. "Deconcentration as Antitrust Policy: The Rise and Fall of the Concentration Ratio," Rivista Internazionale de Scienze Economiche e Commerciali 32: 119-39.

NOTES

1. See Baldwin and Gorecki (1990c) for a more extensive examination of this topic.

2. See Baldwin and Gorecki (1989; 1990d) for a more detailed discussion of the extent of intra-industry mobility in Canadian manufacturing industries.

3. Principal component rather than factor analysis is used for two reasons. First, factor analysis with the indeterminacy associated with the choice of rotation has a less than enviable reputation (Harris, 1975, p.223). Secondly, we were not interested in asking whether there were underlying factors that determined the various measures, but rather how many separate orthogonal components spanned each set of measures. This requires principal component analysis. In the end, however, it did not matter a great deal which technique was used. Factor analysis, using principal components to extract factors, yielded much the same result.

4. Most of the commonly used concentration measures were highly correlated--at levels above .95.

5. Use of the entire sample of mobility and concentration statistics did not change the qualitative conclusions but did increase the space required for the presentation of the results to an unreasonable degree.

6. This was derived using a weight of 1.1 in the formula for the Hannah and Kay firm numbers-equivalent. Choice of different weights (1.5, 2.0, 2.5, 3.0) had little effect on the results reported herein.

7. The subset of variables used here was chosen by looking at which variables were most heavily weighted in the most important components when all variables were used and then retaining the most important for the presentation here.

8. Ijiri and Simon (1977) suggest this as a measure of mobility.

9. Entry and exit due to mergers were not counted as part of share change for calculation of TURNE and TURNC.

10. The principal component analysis was performed on the normalized values of all variables.

11. Median values of the parameters are used because the lack of growth in some industries accompanied by some entry produced very large outliers in the estimate of the entry rate.

12. In some analyses of the determinants of concentration, growth is included. It is omitted here because it is a determinant of mobility, not a dimension of mobility itself.

13. See, for example, the discussion in Curry and George (1983).

14. SCALE uses OLS and a Cobb-Douglas production function because of the robustness of the results. For an extensive discussion of the methodology used, see Baldwin and Gorecki (1986).

15. When multiplant operations were sufficiently infrequent to prevent the estimation of Lyons' MES, the average size of the top four firms' plants was substituted. This only occurred in a small number of industries.

16. This is defined in Baldwin and Gorecki (1986, p.176).

17. Labour is measured by the number of wage and salary earners, capital by end year gross capital stock in constant (1971) dollars.

18. These are defined in Baldwin and Gorecki (1986, p.173 and p.182, respectively).

19. Caves et al. (1980, Table 3.1, p.50).

20. In order, the combined components contain MOB1, MOB2 and SCL1, SCL2, SCL3, SCL4, none of the original components, MOB3, none of the originals, SCL5, none of the originals, MOB5. Only the second combined component groups two of the previously separate components together; but this combined component is not significant in the regression.

21. This section has used the four-firm concentration ratio to investigate whether mobility as well as scale affects market structure. Alternately, the principal components of structure could have been used as regressands. The same qualitative conclusion is reached using this approach. The first two components, which both weight the most commonly-used concentration measures, are related to entry and plant scale. The third component, which captures the importance of the secondary fringe of firms, is related significantly to the mobility variables that were found to be important in the canonical correlation analysis, and also to certain of the scale variables. Therefore, the regression results reported for the four-firm concentration measure generalize to the various dimensions of market structure that were categorized in the first section of the paper.

22. It is noteworthy that there is much less of a regression to the mean phenomenon in Figure 5 than Figure 2. Figure 5 shows that the industries with the greatest increase are, on average, less concentrated than those that experience a decrease in concentration; but the difference is much less than when industries are ranked from lowest to highest on the basis of 1970 concentration. This means that increases are occurring more frequently but not exclusively in the least concentrated industries and vice versa.

23. Using concentration or changes in concentration may violate the homoscedastic assumptions for OLS to provide best linear unbiased estimators. To test for the robustness of the results, a logistic transformation of 1979 and 1970 concentration ratios was employed. The reverse regression yielded an estimate of adjustment which was greater than, not less than,

one; the instrumental variable technique using ranks on observed changes provided an estimate of the same coefficient of 1.25 with standard error of .25.

Table 1

Principal Component Analysis Performed on Concentration and Mobility Variables Separately, Manufacturing Sector, 166 4-Digit Industries, Canada, 1970-1979

Panel A: Concentration[1]

	EIGENVECTORS						
	PRIN1	PRIN2	PRIN3	PRIN4	PRIN5	PRIN6	PRIN7
CR4	-0.4304	0.4171	0.0307	-0.1200	-0.1697	0.6607	0.4001
HF	-0.4451	0.3158	-0.1259	-0.0562	0.6124	-0.4920	0.2570
MCR8	0.1521	0.4644	0.7794	-0.2081	-0.1779	-0.2723	-0.0683
REL84	0.4565	-0.0292	0.3042	0.2705	0.6542	0.3873	0.2172
RELNUM	0.1917	0.6723	-0.3570	0.2902	0.0560	0.1073	-0.5337
VARS	-0.3710	-0.0809	0.2770	0.8597	-0.1744	-0.0976	0.0091
RELRED	0.4591	0.2264	-0.2811	0.2066	-0.3210	-0.2760	0.6611
Proportion of Total Sample Variability Accounted For:	0.5426	0.2201	0.1291	0.0758	0.0267	0.0041	0.0016

Panel B: Mobility[2]

	PRIN1	PRIN2	PRIN3	PRIN4	PRIN5	PRIN6
TURNE	0.6499	-0.0873	-0.0701	0.1024	0.1508	0.7292
TURNC	0.0797	0.6583	0.0194	0.2338	-0.7003	0.1217
TURNM	-0.2088	0.4586	-0.6819	0.2333	0.4741	0.0447
GROW	0.2788	0.4315	0.0069	-0.8398	0.1387	-0.1069
RESGH	-0.3746	0.3503	0.6744	0.0818	0.3931	0.3478
RANK	0.5564	0.1994	0.2738	0.4104	0.2972	-0.5648
Proportion of Total Sample Variability Accounted For:	0.2897	0.2303	0.1550	0.1393	0.1148	0.0709

1. Measured for 1979. These terms are defined in the text and the Variable List.
2. Measure for 1970-1979. These terms are defined in the text and the Variable List.

Source: Special Tabulations. Business and Labour Market Analysis Group, Statistics Canada.

Table 2

Principal Component Analysis, Performed on Concentration and Mobility Variables Together, Manufacturing Sector, 166 4-Digit Industries, Canada, 1970-1979

	EIGENVECTORS						
	PRIN1	PRIN2	PRIN 3	PRIN4	PRIN5	PRIN6	PRIN7
CR4[1]	-0.4209	0.2139	-0.0848	0.0724	0.1583	0.1855	0.0650
HF	-0.4122	0.0846	-0.1503	-0.0026	0.1962	0.2601	0.1251
MCR8	0.0790	0.5083	0.2120	0.4402	-0.1669	-0.1204	-0.0396
REL84	0.4075	0.1283	0.1024	0.1264	-0.2328	-0.1058	0.1234
RELNUM	0.1303	0.5490	-0.2865	-0.1336	0.2296	0.3886	0.1684
VARS	-0.3306	-0.1417	0.1057	0.0990	-0.1940	0.1553	0.2518
RELRED	0.3978	0.2861	-0.1240	-0.1444	0.0818	0.1202	0.0188
TURNE	0.3095	-0.1988	-0.2710	0.2310	0.2173	0.1029	0.2218
TURNC	0.1094	-0.0208	0.4855	-0.2577	0.4522	0.2254	-0.5370
TURNM	-0.0809	0.1386	0.4331	0.2033	0.5478	-0.3976	0.4274
GROW	0.1312	-0.1797	0.3977	0.4075	-0.1382	0.6745	0.1074
REGSH	-0.0459	0.2081	0.3887	-0.5978	-0.3643	0.0622	0.3669
RANK	0.2499	-0.3662	-0.0122	-0.2280	0.2320	0.0658	0.4525
Proportion of Total Sample Variability Accounted For:	0.3451	0.1440	0.1163	0.0812	0.0778	0.0589	0.0544

	PRIN 8	PRIN 9	PRIN10	PRIN11	PRIN12	PRIN13
CR4[1]	0.1100	-0.1999	-0.0463	-0.2217	0.6560	0.4090
HF	0.1106	-0.2054	0.0261	0.5680	-0.4880	0.2504
MCR8	0.4667	-0.3054	-0.0885	-0.2359	-0.2700	-0.0727
REL84	0.2254	0.1679	-0.0043	0.6563	0.3872	-0.2253
RÈLNUM	-0.0235	0.2132	-0.0610	0.0613	0.1169	-0.5315
VARS	0.4145	0.7049	0.1423	-0.1647	-0.0913	0.0092
RELRED	-0.1663	0.2749	-0.0800	-0.2783	-0.2908	-0.6561
TURNE	0.1570	-0.1968	0.7438	-0.1172	0.0157	0.0166
TURNC	0.3273	0.0698	0.1594	0.0527	0.0389	0.0082
TURNM	-0.2824	0.1476	0.0379	0.0364	-0.0116	-0.0109
GROW	-0.3424	-0.0913	-0.1222	-0.0071	0.0058	-0.0098
RESGH	-0.0514	-0.2496	0.3265	-0.0560	-0.0131	0.0043
RANK	0.4190	-0.2061	-0.5073	-0.1116	-0.0105	-0.0195
Proportion of Total Sample Variability Accounted For:	0.0410	0.0371	0.0284	0.0129	0.0021	0.0008

1. For variable definitions, see the Variable List.

Source: Special Tabulations. Business and Labour Market Analysis Group, Statistics Canada.

Table 3

Canonical Correlation Analysis for Concentration and Mobility Variables, Manufacturing Sector, 166 4-Digit Industries, Canada, 1970-1979.

CORRELATIONS BETWEEN THE CONCENTRATION[1] VARIABLES AND THEIR CANONICAL VARIABLES

	V1	V2	V3	V4	V5	V6
CR4	-0.9452	-0.0064	-0.2891	0.0214	0.0713	-0.0538
HF	-0.7591	0.0793	-0.4409	-0.0186	-0.0028	-0.3255
MCR8	-0.2631	-0.4773	0.6976	0.4194	0.1978	-0.0284
REL84	0.7205	-0.1521	0.4245	0.5233	0.0406	0.0366
RELNUM	0.0516	-0.7056	-0.2982	0.4132	0.0596	0.3512
VARS	-0.5824	0.5175	0.0252	0.0691	-0.5763	0.0825
RELRED	0.6517	-0.5228	0.0618	0.1897	0.1235	0.4794

CORRELATIONS BETWEEN THE MOBILITY[2] VARIABLES AND THEIR CANONICAL VARIABLES

	W1	W2	W3	W4	W5	W6
TURNE	0.8215	-0.3236	0.0050	0.2025	0.2172	-0.3636
TURNC	0.2478	-0.2731	0.4516	-0.6374	0.0523	0.5010
TURNM	-0.3325	0.0346	0.4030	0.0609	0.8257	0.2008
GROW	0.2884	0.3471	0.8407	0.0801	-0.2089	-0.1986
RESGH	-0.1113	0.0136	0.1186	0.4744	-0.2420	0.8305
RANK	0.8054	0.4649	-0.1671	-0.1121	0.2509	0.1782

1. Measured for 1979. These terms are defined in the text and in the Variable List.
2. Measured for 1970-1979. These terms are defined in the text and in the Variable List.

Source: Special Tabulations. Business and Labour Market Analysis Group, Statistics Canada.

Table 4

The Determinants of Concentration, Measured as CR4, for 1979, Regression Analysis Across 162 4-digit Industries, Manufacturing, Canada, 1970-1979

Independant Variables[1]	Equation #1 OLS	Equation #2 TSLS		Equation #3
Intercept	0.3382 (3.75)*	0.5571 (3.59)*	Intercept	0.5813 (9.04)*
TURNE	-0.8005 (-6.36)*	-1.6189 (-3.94)*	TURNE	-0.8005 (-6.36)*
TURNC	-0.1881 (-1.12)	-0.2750 (-1.27)	TURNC	-0.1882 (-1.12)
GROW	-0.0262 (-1.38)	-0.0252 (-1.27)	GROW	-0.0262 (-1.38)
RANK	-0.0038 (-1.28)	0.0001 (0.15)	RANK	-0.0038 (-1.28)
REGSH	0.1214 (2.08)**	0.0917 (0.99)	REGSH	0.1214 (2.08)**
SCALE	0.0092 (0.20)	0.0272 (0.47)	SCL1	0.0594 (5.02)*
BMES	2.543 (9.61)*	2.603 (5.05)*	SCL2	0.0666 (5.74)*
CDR	52.96 (1.14)	55.76 (0.92)	SCL3	-0.0246 (-2.15)**
KL	0.0011 (3.94)*	0.0009 (2.64)*	SCL4	-0.0527 (-4.65)*
ADV	0.2006 (0.26)	-0.8447 (0.41)	SCL5	0.0687 (5.90)*
RD	-6.943 (-0.09)	-94.68 (-0.80)	SCL6	0.0185 (1.64)
R^2	0.6410	0.4443		0.6410
F-Ratio	27.13*	12.05*		27.13*

1. See text and the Variable List for variable definitions.
2. Equation #2 was estimated using only 153 observations.

* Significantly different from zero at .01
** Significantly different from zero at .05
*** Significantly different from zero at .10

Source: Special Tabulations. Business and Labour Market Analysis Group, Statistics Canada.

Table 5

Principal Component Analysis Performed on Scale and Mobility Variables Separately, Manufacturing Sector, 166 4-Digit Industries, Canada, 1970-1979

Panel A: Concentration[1]

	EIGENVECTORS					
	SCL1	SCL2	SCL3	SCL4	SCL5	SCL6
SCALE	0.5527	-0.0503	-0.4595	0.2816	-0.3593	0.5219
BMES	0.1608	0.5092	-0.4542	-0.4816	0.5173	0.0949
CDR	0.6680	-0.2477	-0.0334	0.0862	0.2088	-0.6635
KL	0.3928	0.0277	0.7011	-0.0114	0.3702	0.4649
AD	-0.1075	0.5029	-0.0274	0.8034	0.2809	-0.1018
RD	0.2376	0.6505	0.2986	-0.1891	-0.5862	-0.2276
Proportion of Total Sample Variability Accounted For:	0.245	0.206	0.192	0.158	0.112	0.087

Panel B: Mobility[2]

	MOB1	MOB2	MOB3	MOB4	MOB5
TURNE	0.6404	-0.2169	0.1022	0.0975	0.7231
TURNC	0.1655	0.6658	0.0999	-0.7080	0.1344
GROW	0.3296	0.4242	-0.7609	0.3488	-0.1041
RANK	0.5769	0.1428	0.5147	-0.2332	-0.5722
REGSH	-0.3480	0.5562	0.3684	0.5596	0.3474
Proportion of Total Sample Variability Accounted For:	0.3420	0.2532	0.1694	0.1499	0.0854

1. Measured for 1979. These terms are defined in the text and in the Variable List.
2. Measured for 1970-1979. These terms are defined in the text and in the Variable List.

Source: Special Tabulations. Business and Labour Market Analysis Group, Statistics Canada.

Table 6

The Determinants of Concentration, Measured as CR4, for 1979, Regression Analysis Across 162 4-digit Industries, Manufacturing, Canada, 1970-1979

Independant Variables[1]	Equation #1		Equation #2
Intercept	0.5005 (45.48)*	Intercept	0.5021 45.47
MOB1	-0.1134 (-9.39)*	PRIN1	0.1672 (15.09)*
MOB2	0.0182 (1.60)	PRIN2	0.0186 (1.68)
MOB3	0.0015 (0.14)	PRIN3	-0.0380 (-3.43)*
MOB4	0.0046 (0.40)	PRIN4	0.0174 (1.58)
MOB5	-0.0321 (-2.72)*	PRIN5	-0.0446 (-4.02)*
SCL1	0.0594 (5.02)*	PRIN6	0.0170 (1.533)
SCL2	0.0667 (5.73)*	PRIN7	-0.0091 (-0.826)
SCL3	-0.0246 (2.15)**	PRIN8	-0.0088 (-0.792)
SCL4	-0.0527 (-4.65)	PRIN9	0.0038 (3.47)*
SCL5	0.0687 (5.90)*	PRIN10	0.0035 (0.32)
SCL6	0.0185 (1.64)***	PRIN11	-0.0513 (-4.63)*
R^2	0.6410		0.6410
F-Ratio	27.13		27.13

1. See text and the Variable List for variable definitions.

* Significantly different from zero at .01

** Significantly different from zero at .05

*** Significantly different from zero at .10

Source: Special Tabulations. Business and Labour Market Analysis Group, Statistics Canada.

Table 7

Principal Component Analysis Performed on Scale and Mobility Variables Together, Manufacturing Sector, 166 4-Digit Industries, Canada, 1970-1979

	EIGENVECTORS						
	PRIN1	PRIN2	PRIN 3	PRIN4	PRIN5	PRIN6	PRIN7
TURNE	-0.5035	-0.2678	-0.1844	-0.0130	0.0040	0.2709	0.1330
TURNC	-0.1240	0.2768	0.5400	0.3226	-0.0190	0.0504	0.1155
GROW	-0.2702	0.2136	0.1235	0.4230	0.3463	0.2673	-0.5826
RANK	-0.4894	0.0050	0.1546	-0.0137	-0.0075	0.1102	0.5587
REGSH	0.1934	0.5180	0.0758	0.2177	-0.4395	-0.1900	0.1336
SCALE	0.2119	-0.3990	0.1405	0.5720	0.0956	-0.1534	0.3599
BMES	0.2277	-0.0620	-0.5183	0.3286	-0.2930	0.3601	-0.0002
CDR	0.2764	-0.5154	0.3125	0.1277	0.0770	0.0438	-0.1426
KL	0.3138	-0.0066	0.3873	-0.4642	0.1047	0.2643	0.0335
AD	0.1159	0.2145	-0.3012	0.0395	0.7068	-0.3780	0.2146
RD	0.3100	-0.2511	-0.0524	0.0280	0.2739	0.6607	0.3201
Proportion of Total Sample Variability Accounted For:	0.1951	0.1337	0.1250	0.1013	0.0925	0.0855	0.0732

	PRIN 8	PRIN 9	PRIN10	PRIN11
TURNE	-0.1046	0.3345	-0.0620	0.6502
TURNC	0.6666	0.0437	0.2220	0.0244
GROW	0.2957	0.1423	-0.1876	-0.1157
RANK	0.3612	0.1324	0.1603	-0.4882
REGSH	0.4116	0.3200	0.0322	0.3481
SCALE	0.0548	-0.0711	-0.5267	0.0359
BMES	-0.2497	0.3830	0.0964	-0.3658
CDR	0.2539	0.1908	0.6353	0.1067
KL	-0.0471	0.5392	-0.3890	-0.0989
AD	-0.0859	0.3463	0.1780	0.0278
RD	0.1339	-0.3836	0.1075	0.2160
Proportion of Total Sample Variability Accounted For:	0.0611	0.0580	0.0447	0.0300

1. For variable definitions, see Variable List.

Source: Special Tabulations. Business and Labour Market Analysis Group, Statistics Canada.

The Relative Importance of the Principal Components of Concentration and Mobility Statistics

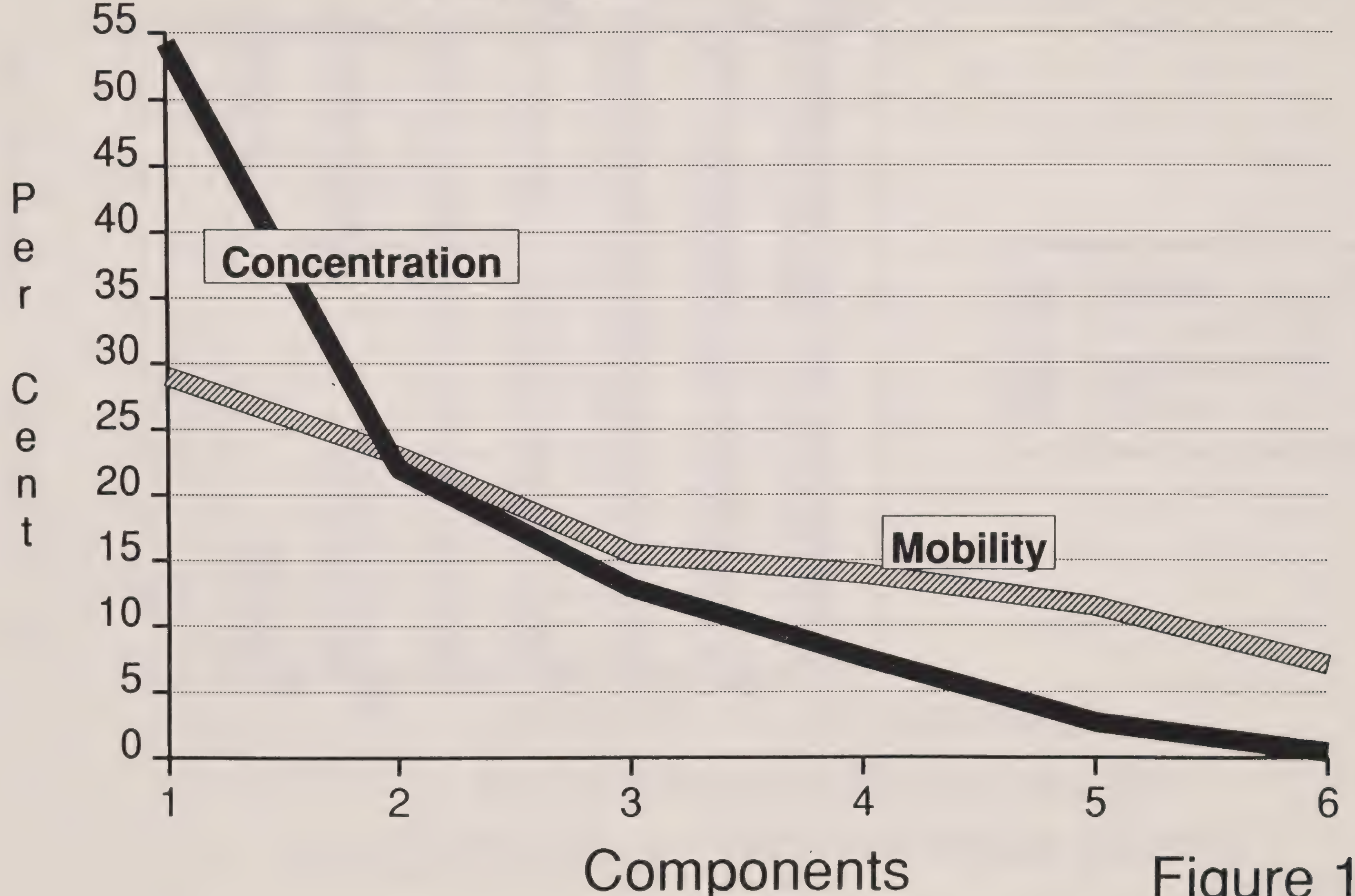
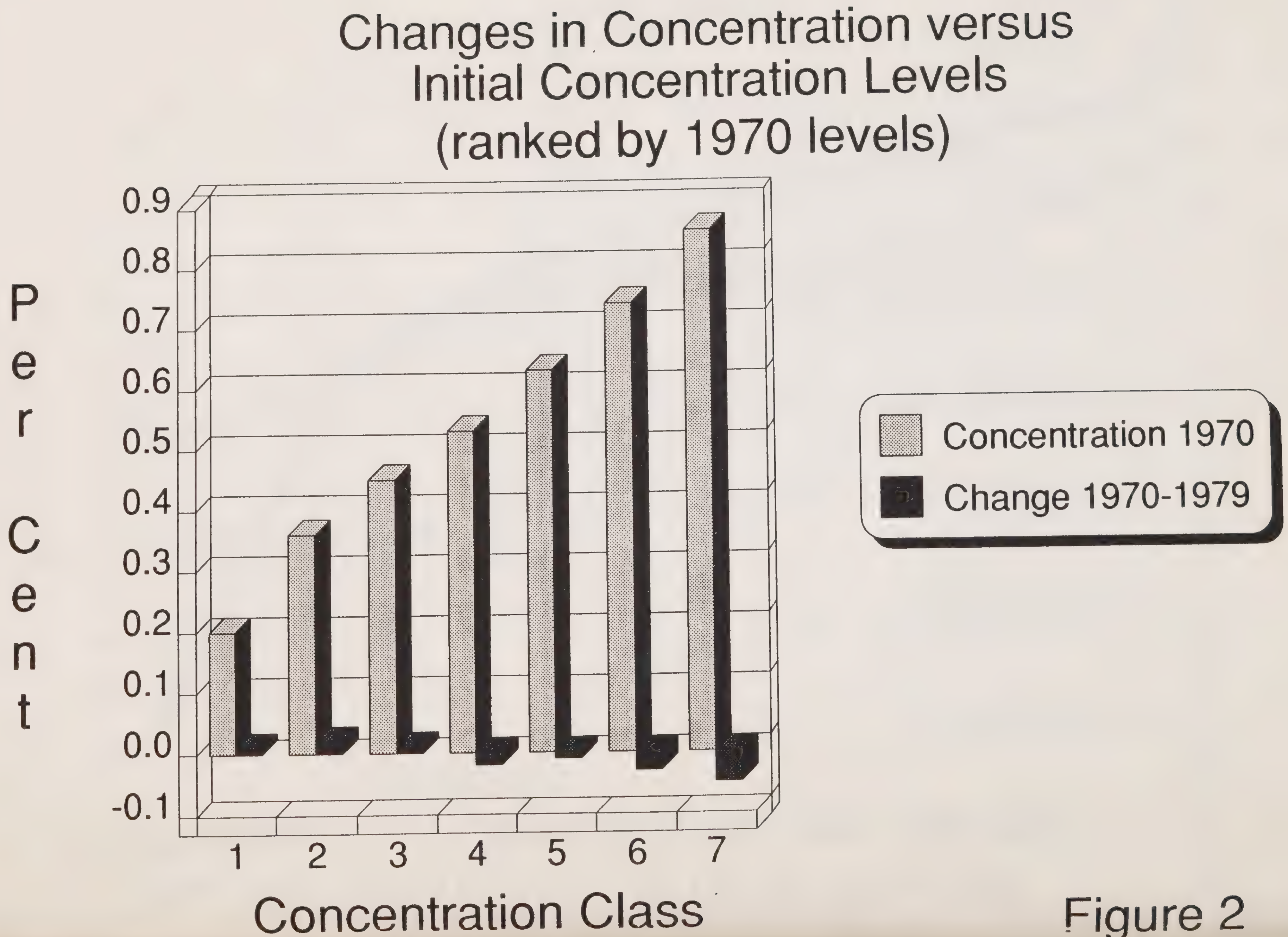


Figure 1



Changes in Concentration versus
Initial Concentration Levels
(ranked by 1970 levels)
Per Cent
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
-0.1
1
2
3
4
5
6
7
Concentration Class
Concentration 1970
Change 1970-1979

Figure 2

Changes in Concentration versus Initial Concentration Levels (ranked by 1979 levels)

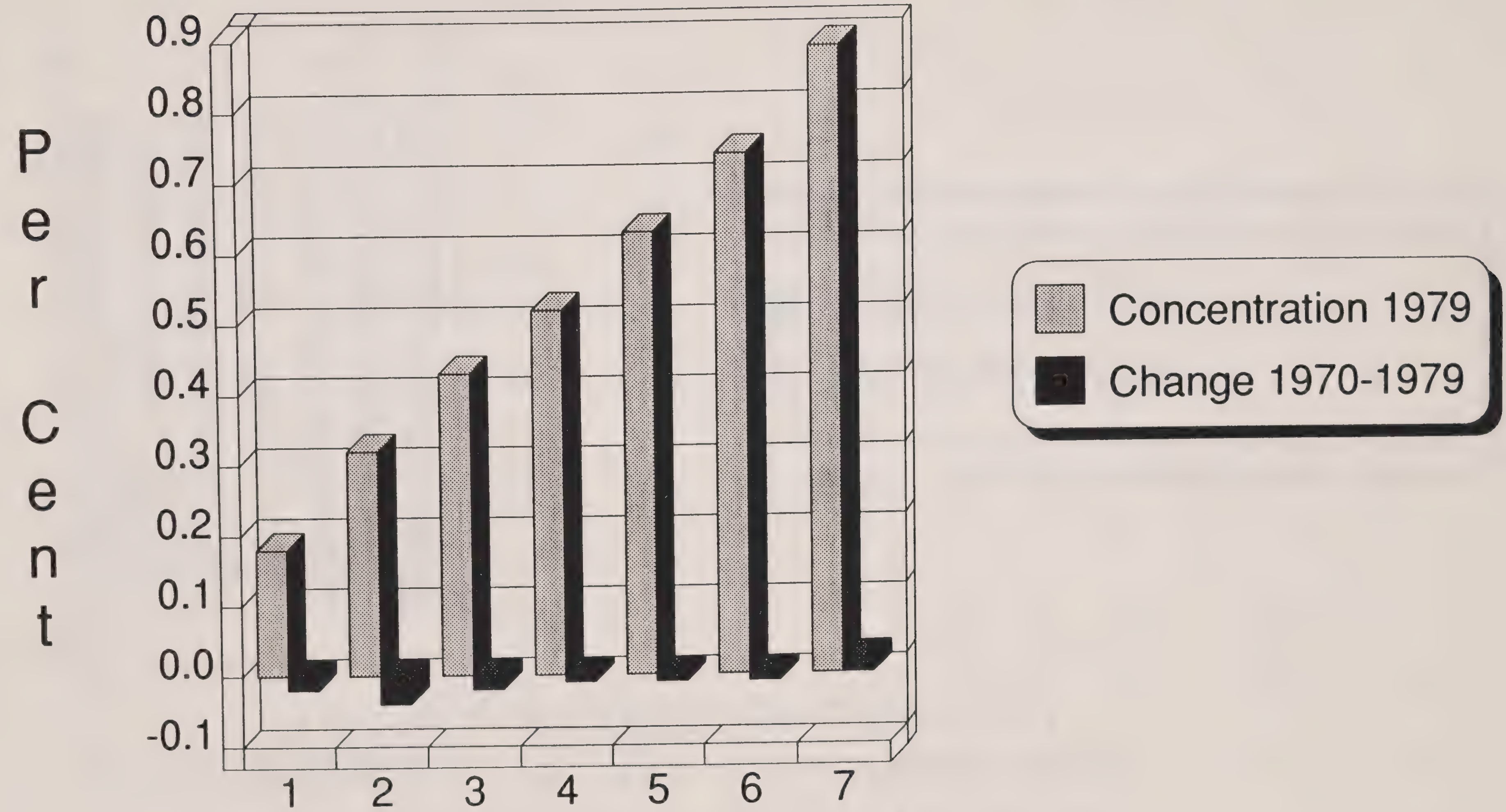


Figure 3

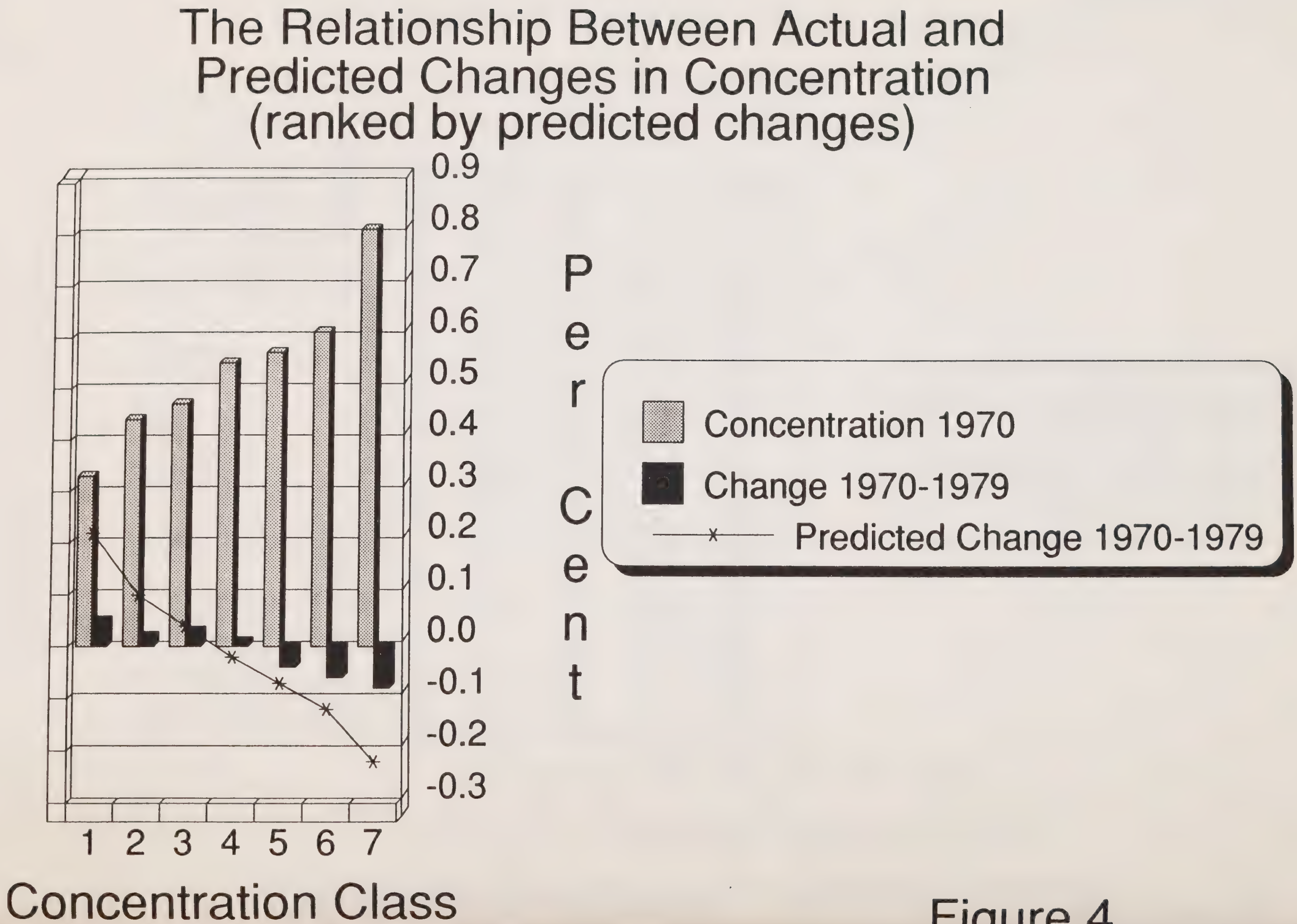

The Relationship Between Actual and
Predicted Changes in Concentration
(ranked by predicted changes)
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
-0.1
-0.2
-0.3
Per Cent
Concentration 1970
Change 1970-1979
Predicted Change 1970-1979
1
2
3
4
5
6
7
Concentration Class

Figure 4

The Relationship Between Actual and Predicted Changes in Concentration (ranked by actual changes)

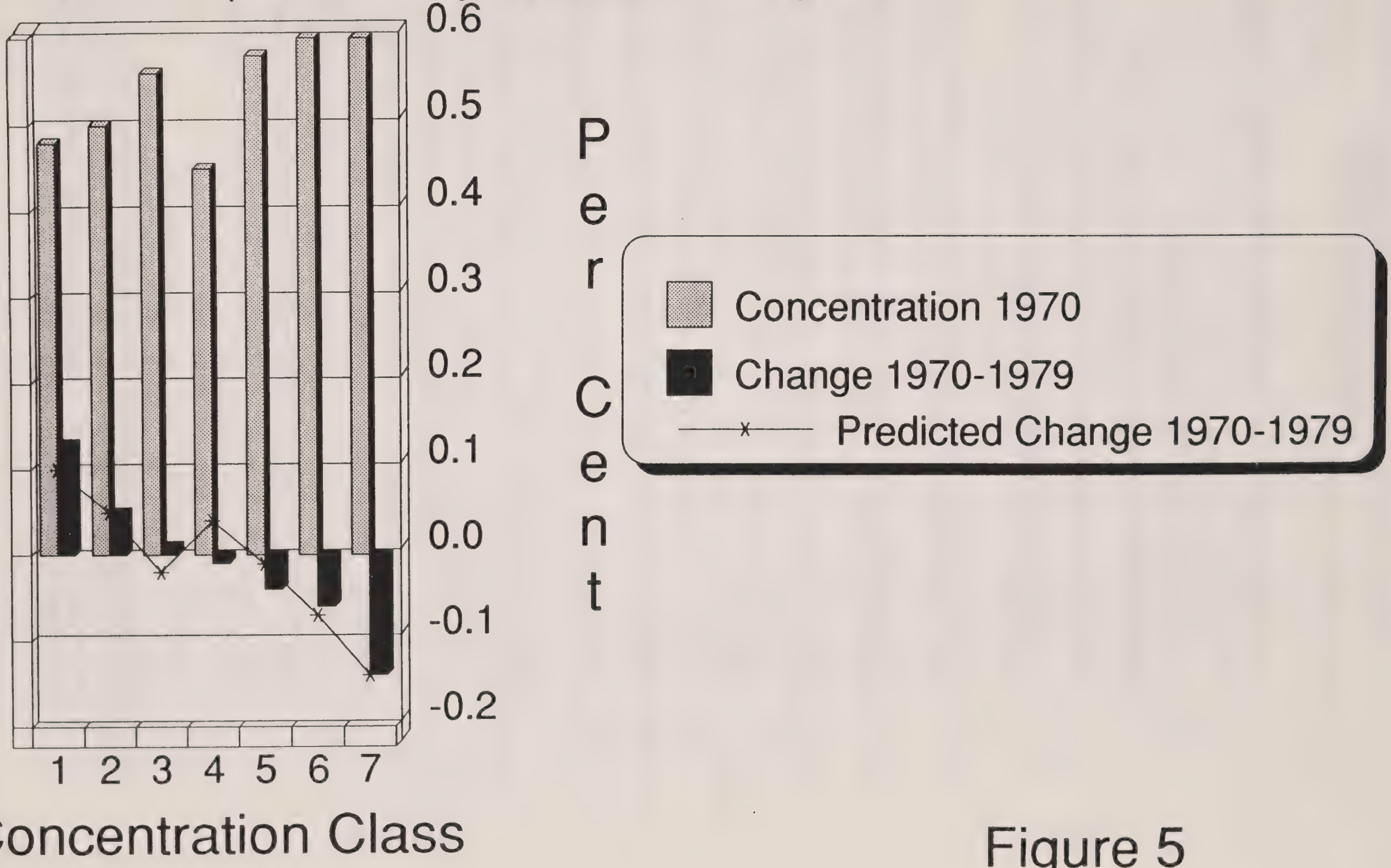


Figure 5

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